CLAIMS

We claim:

1. A semiconductor structure for providing cross-point switching functionality comprising:

a monocrystalline silicon substrate;

an amorphous oxide material overlying the monocrystalline silicon substrate;

a monocrystalline perovskite oxide material overlying the amorphous oxide material;

a monocrystalline compound semiconductor material overlying the monocrystalline perovskite oxide material, and including an optical source component, the optical source component being operable to generate a radiant energy transmission;

a diffraction grating optically coupled with the optical source and having a configuration for passing the radiant energy transmission in a predetermined radiant energy intensity pattern forming a plurality of replications of the radiant energy transmission; and

at least one optical switch component optically coupled to the diffraction grating and corresponding to at least one of the replicated radiant energy transmissions and having a first state for passing the at least one replicated radiant energy transmission, and a second state prohibiting passage of the at least one replicated radiant energy transmission.

2. The semiconductor structure of claim 1 further comprising a first optical interconnect optically coupled between the optical source and the diffraction grating for conveying the radiant energy transmission between the optical source and the diffraction grating, and a second optical interconnect optically coupled between the diffraction grating and the at least one optical switch for conveying the replicated radiant energy transmissions between the diffraction grating and the at least one optical switch.

3. The semiconductor structure of claim 2 wherein the optical interconnect is an optical waveguide.

4. The semiconductor structure of claim 3 wherein the optical waveguide is formed from one of an organic material, an inorganic material, and a gas medium.

5. The semiconductor structure of claim 4 wherein the organic material includes at least one of a polycarbonate, a polystyrene, a polymethyl methacrylate, a poly sulfone, a polyimide and a polyurethane material.

6. The semiconductor structure of claim 4 wherein the inorganic material includes at least one of a silica, a lithium niobate, a lead lanthanum zirconate titanate and a barium titanate (BTO) material.

7. The semiconductor structure of claim 1 wherein the diffraction grating is a first diffraction grating having a first configuration for passing the radiant energy transmission in a first predetermined radiant energy intensity pattern, and further comprising a second diffraction grating optically coupled between the first diffraction grating and the at least one optical switch, the second diffraction grating having a second configuration for passing at least one of the replicated radiant energy transmissions in a second predetermined radiant energy intensity pattern.

8. The semiconductor structure of claim 7 wherein the first configuration of the first diffraction grating is identical to the second configuration of the second diffraction grating.

9. The semiconductor structure of claim 1 wherein the monocrystalline compound semiconductor material further includes an optical detector component optically coupled to the at least one optical switch for generating a detection signal responsive to receipt of at least one of the replicated radiant energy transmissions.

10. The semiconductor structure of claim 9, wherein the optical detector component is one of a photodetector and a photoelectric detector.

11. The semiconductor structure of claim 10, wherein the photodetector is one of a photodiode and a phototransistor.

12. The semiconductor structure of claim 10, wherein the photoelectric detector comprises a group III-V compound semiconductor detector.

13. The semiconductor structure of claim 12, wherein the group III-V compound semiconductor detector is one of a gallium arsenide (GaAs) detector, an indium phosphide (InP) detector, an indium gallium arsenide (InGaAs) detector, an indium aluminum arsenide (InAlAs) detector, an aluminum gallium arsenide (AlGaAs) detector, an indium aluminum gallium arsenide (InAlGaAs) detector, an indium gallium arsenide phosphide (InGaAsP) detector, and an indium gallium arsenide nitride (InGaAsN) detector.

14. The semiconductor structure of claim 9, wherein the optical detector component generates the detection signal in response to a transmission value exceeding a threshold value, and wherein the transmission value is associated with the replicated radiant energy transmission intensity.

15. The semiconductor structure of claim 14, wherein the threshold value is one of a current value and a voltage value.

16. The semiconductor structure of claim 1 further comprising an optical coupler component optically coupled to the at least one optical switch for optically coupling corresponding replicated radiant energy transmissions to components external to the semiconductor structure.

17. The semiconductor structure of claim 1 wherein the optical switch includes a single-pole, single-throw optical switch.

18. The semiconductor structure of claim 1 wherein the optical switch includes a Micro Electro-Mechanical Systems component.

19. The semiconductor structure of claim 1 wherein the optical source component is a group III-V compound semiconductor laser.

20. The semiconductor structure of claim 19, wherein the group III-V compound semiconductor laser is one of a gallium arsenide (GaAs) laser, an indium phosphide (InP) laser, an indium gallium arsenide (InGaAs) laser, an indium aluminum arsenide (InAlAs) laser, an aluminum gallium arsenide (AlGaAs) laser, an indium aluminum gallium arsenide (InAlGaAs) laser, an indium gallium arsenide phosphide (InGaAsP) laser, and an indium gallium arsenide nitride (InGaAsN) laser.

21. The semiconductor structure of claim 1, wherein the radiant energy transmission is one of an ultraviolet transmission, an infrared transmission, and a beam of visible light.

22. A process for fabricating a semiconductor structure for providing cross-point switch functionality comprising the steps of:

providing a monocrystalline silicon substrate;

depositing a monocrystalline perovskite oxide film overlying the monocrystalline silicon substrate, the film having a thickness less than a thickness of the material that would result in strain-induced defects;

forming an amorphous oxide interface layer at an interface between the monocrystalline perovskite oxide film and the monocrystalline silicon substrate;

epitaxially forming a monocrystalline compound semiconductor layer overlying the monocrystalline perovskite oxide film, the monocrystalline compound semiconductor layer including an optical source component, the optical source component being operable to generate a radiant energy transmission;

forming a diffraction grating optically coupled with the optical source and having a configuration for passing the radiant energy transmission in a predetermined radiant energy intensity pattern forming a plurality of replications of the radiant energy transmission; and

forming at least one optical switch component optically coupled to the diffraction grating and corresponding to at least one of the replicated radiant energy transmissions and having a first state for passing the at least one replicated radiant energy transmission, and a second state prohibiting passage of the at least one replicated radiant energy transmission.

23. The process of claim 22 further comprising forming a first optical interconnect optically coupled between the optical source and the diffraction grating for conveying the radiant energy transmission between the optical source and the diffraction grating, and forming a second optical interconnect optically coupled between the diffraction grating and the at least one optical switch for conveying the replicated radiant energy transmissions between the diffraction grating and the at least one optical switch.

24. The process of claim 23 wherein the optical interconnect is an optical waveguide.

25. The process of claim 24 wherein the optical waveguide is formed from one of an organic material an inorganic material and a gas medium.

26. The process of claim 25 wherein the organic material includes at least one of a polycarbonate, a polystyrene, a polymethyl methacrylate, a poly sulfone, a polyimide and a polyurethane material.

27. The process of claim 25 wherein the inorganic material includes at least one of a silica, a lithium niobate, a lead lanthanum zirconate titanate and a barium titanate (BTO) material.

28. The process of claim 22 wherein the diffraction grating is a first diffraction grating having a first configuration for passing the radiant energy transmission in a first predetermined radiant energy intensity pattern, and further comprising forming a second diffraction grating optically coupled between the first diffraction grating and the at least one optical switch, the second diffraction grating having a second configuration for passing at least one of the replicated radiant energy transmissions in a second predetermined radiant energy intensity pattern.

29. The process of claim 28 wherein the first configuration of the first diffraction grating is identical to the second configuration of the second diffraction grating.

30. The process of claim 22 wherein the forming the monocrystalline compound semiconductor material further includes forming an optical detector component optically coupled to the at least one optical switch for generating a detection signal responsive to receipt of at least one of the replicated radiant energy transmissions.

31. The process of claim 30, wherein the optical detector component is one of a photodetector and a photoelectric detector.

32. The process of claim 31, wherein the photodetector is one of a photodiode and a phototransistor.

33. The process of claim 31, wherein the photoelectric detector comprises a group III-V compound semiconductor detector.

34. The process of claim 33, wherein the group III-V compound semiconductor detector is one of a gallium arsenide (GaAs) detector, an indium phosphide (InP) detector, an indium gallium arsenide (InGaAs) detector, an indium aluminum arsenide (InAlAs) detector, an aluminum gallium arsenide (AlGaAs) detector, an indium aluminum gallium arsenide (InAlGaAs) detector, an indium gallium arsenide phosphide (InGaAsP) detector, and an indium gallium arsenide nitride (InGaAsN) detector.

35. The process of claim 30, wherein the optical detector component generates the detection signal in response to a transmission value exceeding a threshold

value, and wherein the transmission value is associated with the replicated radiant energy transmission intensity.

36. The process of claim 35, wherein the threshold value is one of a current value and a voltage value.

37. The process of claim 22 further comprising forming an optical coupler component optically coupled to the at least one of the at least one optical switches for optically coupling corresponding replicated radiant energy transmissions to components external to the process.

38. The process of claim 22 wherein the optical switch includes a single-pole, single-throw optical switch.

39. The process of claim 22 wherein the optical switch includes a Micro Electro-Mechanical Systems component.

40. The process of claim 22 wherein the optical source component is a group III-V compound semiconductor laser.

41. The process of claim 40, wherein the group III-V compound semiconductor laser is one of a gallium arsenide (GaAs) laser, an indium phosphide (InP) laser, an indium gallium arsenide (InGaAs) laser, an indium aluminum arsenide (InAlAs) laser, an aluminum gallium arsenide (AlGaAs) laser, an indium aluminum gallium arsenide (InAlGaAs) laser, an indium gallium arsenide phosphide (InGaAsP) laser, and an indium gallium arsenide nitride (InGaAsN) laser.

42. The process of claim 22, wherein the radiant energy transmission is one of an ultraviolet transmission, an infrared transmission, and a beam of visible light.